Acinetobacter Species Infections among Navy and Marine Corps Beneficiaries: 2014 Annual Report

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By Paul Meddaugh and Uzo Chukwuma
EpiData Center Department
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14. ABSTRACT

Since the early 2000s, health professionals are increasingly concerned about Acinetobacter species infections due to demonstrated ability to develop resistance to multiple antibiotics, limiting treatment options. In 2014, Acinetobacter incidence was 3.2 and 4.7 per 100,000 persons per year in the Department of the Navy (DON) and the Department of Defense (DOD), respectively, both of which were a slight increase from 2013. Active duty Marines had a higher burden than that of any other service members. Acinetobacter species, not otherwise specified, was the most common etiologic agent in 2014. In the DON, a decrease in the overall burden of resistance was observed, as well as an overall decrease in the severity of resistance seen. For non-multidrug-resistant (MDR) cases in the DON and DOD, providers often prescribed trimethoprim/sulfamethoxazole, consistent with 2012 observations. For multidrug-resistant cases in 2014, DON providers most commonly prescribed cefazolin; DOD providers most commonly prescribed ciprofloxacin and trimethoprim/sulfamethoxazole for these cases. Although slightly different from 2013, 2014 prescribing patterns were consistent with recommendations. Among DON beneficiaries organisms were most susceptible to gentamicin while least susceptible to ceftriaxone. Among DOD beneficiaries, organisms were most susceptible to ampicillin/sulbactam and least susceptible to nitrofurantoin, similar to past observations for the DON and DOD.

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Abstract

Since the early 2000s, health professionals are increasingly concerned about *Acinetobacter* species infections due to demonstrated ability to develop resistance to multiple antibiotics, limiting treatment options. In 2014, *Acinetobacter* incidence was 3.2 and 4.7 per 100,000 persons per year in the Department of the Navy (DON) and the Department of Defense (DOD), respectively, both of which were a slight increase from 2013. Active duty Marines had a higher burden than that of any other service members. *Acinetobacter* species, not otherwise specified, was the most common etiologic agent in 2014. In the DON, a decrease in the overall burden of resistance was observed, as well as an overall decrease in the severity of resistance seen. For non-multidrug-resistant (MDR) cases in the DON and DOD, providers often prescribed trimethoprim/sulfamethoxazole, consistent with 2012 observations. For multidrug-resistant cases in 2014, DON providers most commonly prescribed cefazolin; DOD providers most commonly prescribed ciprofloxacin and trimethoprim/sulfamethoxazole for these cases. Although slightly different from 2013, 2014 prescribing patterns were consistent with recommendations. Among DON beneficiaries organisms were most susceptible to gentamicin while least susceptible to ceftriaxone. Among DOD beneficiaries, organisms were most susceptible to ampicillin/sulbactam and least susceptible to nitrofurantoin, similar to past observations for the DON and DOD. An overall increase in susceptibility for most antibiotics was identified.

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Executive Summary

The EpiData Center Department (EDC) at the Navy and Marine Corps Public Health Center (NMCPHC) conducts routine surveillance of clinically significant organisms within the Department of the Navy (DON), as well as the Department of Defense (DOD). This report provides a summary of *Acinetobacter* species incidence and prevalence in calendar year (CY) 2014 and describes the demographics, clinical characteristics, prescription practices, and antibiotic resistance patterns observed among all DOD beneficiaries as well as active duty DON service members and recruits.

Linking several data sources in this report allows for the assessment of a variety of unique descriptive and clinical factors related to *Acinetobacter* within multiple populations. Composite Healthcare System (CHCS) Health Level 7 (HL7) formatted microbiology data were used to identify *Acinetobacter* cases. These isolates were matched to three databases. Microbiology records were matched to HL7 formatted pharmacy data to assess prescribing practices associated with *Acinetobacter* cases. Cases were also matched to the Standard Inpatient Data Record (SIDR) database to determine exposure associations within the healthcare system. Microbiology records were matched to the Defense Manpower Data Center (DMDC) active duty roster to determine the burden of *Acinetobacter* among active duty DON service members and recruits. The linking of these various data sources allowed for the broadest view of *Acinetobacter* among DOD health care beneficiaries seeking care within the Military Health System (MHS).

This summary of *Acinetobacter* incidence within the MHS in CY 2014 follows previously observed disease dynamics with normal seasonal and geographic patterns and an overall descending trend in incidence, despite a negligible increase in 2014. A similar descending trend with a slight increase in 2014 was observed among DON active duty service members. Additionally, active duty Marines presented a burden much higher than active duty members of other services, indicating potentially unique exposure for this population. The prevalence of multidrug-resistant (MDR) *Acinetobacter* remains low in the DOD with one possible extensively drug-resistant (PXDR) and two XDR cases identified. No possible pandrug-resistant (PPDR) or PDR cases were found. The majority of *Acinetobacter* species cases in all populations was found in the outpatient setting, manifested as non-sterile or skin and soft tissue infections (SSTI). Antibiotic resistance patterns have remained relatively stable with several treatment options showing good susceptibility MHS-wide. Additionally, an overall increase in susceptibility was noted in most antibiotics. Understanding the current disease dynamics will help ensure military health providers have the best information possible, thus promoting quality care and mission readiness.

Introduction

Acinetobacter species are gram-negative bacteria that have shown significant increases in resistance to traditional antibiotics over the past several decades. The most clinically important species are *A. baumannii*, *Acinetobacter* genomic species 3, and *Acinetobacter* genomic species 13TU, which are associated with a large number of infections and demonstrate a remarkable ability to acquire resistance.[1-3] Using normal phenotypic tests, these three species, plus *A. calcoaceticus* (a common environmental organism not associated with clinically relevant disease), are difficult to distinguish from one another. Because genetic testing is not always practical, experts commonly refer to these four species as the *A. baumannii-calcoaceticus* complex, or ABC.[1-5] *Acinetobacter* species other than the three clinically relevant species already mentioned are rarely implicated in clinical infection and are not of significant concern.[2]

The ease and frequency of human travel around the world creates a significant risk for acquisition and transmission of novel infections and/or novel resistance strains.[6] Multiple European, North American, and Asian hospitals reported endemic levels of *Acinetobacter* isolates displaying multidrug resistance, as have hospitals in Argentina, Brazil, some South Pacific Island nations, and the Middle East.[6] The presence of endemic MDR *Acinetobacter* around the world allows for the potential movement of these differing resistance strains into new environments thus creating novel infections within these new environments. Furthermore, this creates a risk that MDR strains will pick up new resistance determinants from novel strains, and vice versa, potentially creating an even more highly resistant organism.

Certain climatic conditions facilitate the transmission of *Acinetobacter* in the community as well as in the hospital environment.[4] *Acinetobacter* species are hydrophilic and therefore thrive in hot and humid environments,[4] thus infections peak in summer and fall months. Although indoor temperatures are kept relatively stable through heating, ventilation, and air conditioning systems, changes in outdoor humidity can alter moisture levels within buildings, allowing for seasonal variation of *Acinetobacter* infections within the hospital environment.[7]

Experts consider *Acinetobacter* to be ubiquitous in nature as various species have been isolated from soil and surface water samples; however, this has led to the misconception that *A. baumannii* is also pervasive.[8-11] *A. baumannii* is rarely a component of normal human skin flora and has a low incidence of colonization.[2] Infections related to *A. baumannii* typically target moist tissues (e.g., mucous membranes) or areas of exposed skin.[12] At particular risk for *A. baumannii* infection are military service members deployed to combat theaters of operation, particularly in the Middle East.[13]

Historically, categorization of antibiotic resistance in bacteria was challenging because of a lack of standard definitions. In recent years, however, international experts established consistent definitions and categorized bacterial resistance into five groups: MDR, PXDR, XDR, PPDR, and PDR.[21] Refer to Appendix A (Table A1) for group definitions as well as antibiotic categories specific to *Acinetobacter*.

MDR *Acinetobacter* species infections occur with greater frequency in United States (US) service members injured in Middle Eastern countries compared to their counterparts stationed in the US.[6,13-20] Providers frequently isolate antibiotic-resistant *Acinetobacter* infections, most often ABC, from US service members wounded during combat in support of Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF).[16] Clinicians have estimated that the mortality associated with *Acinetobacter* infections complicating combat injuries is as high as 30%.[6] Furthermore, isolates identified from service members returning from OEF and OIF missions were significantly more antibiotic resistant than isolates commonly found in the US, including those found in non-deployed service members.[17,18] Of service members medically evacuated from Iraq and Afghanistan from March 2003 through February 2005, 89% had isolates resistant to at least three different antimicrobial classes.[18]

Acinetobacter is adept at responding to antimicrobial pressure and develops resistance much more quickly than most bacteria. Various strains have developed resistance to all currently available antibiotics.[11,21] Posing further infection control challenges, *A. baumannii* has a remarkable survivability for prolonged lengths of time in the hospital environment, sometimes lasting up to several years.[11] Despite the prevalence of *A. baumannii* in the hospital environment, data describing community carriage are rare and there is disagreement as to whether extra-hospital reservoirs even exist. Evidence of community carriage/reservoirs have only been discussed in the literature for the past 15 years and focus only on single events or cases.[11] *A. baumannii* strains known to infect humans have also been isolated from animals, logically leading to the hypothesis that they could establish a community reservoir. Veterinary nosocomial spread has been described among animals, mainly in veterinary hospital intensive care units. This suggests the possible existence of an extensive community reservoir with the potential for zoonotic spread.[11,22]

The EpiData Center Department (EDC) conducts routine bacteriology and antibiotic susceptibility surveillance using electronic health data including microbiology culture and antibiotic susceptibility results, inpatient encounter records, and active duty rosters. This report updates previously reported retrospective incidence rates. It further describes the demographics, clinical characteristics, prescription practices, and antibiotic susceptibility patterns for cases of *Acinetobacter* species among Department of the Defense (DOD) beneficiaries as well as Department of the Navy (DON) active duty service members and recruits.

Methods

Study Design, Setting, and Population

This annual report is a retrospective surveillance summary for calendar year (CY) 2014 assessing the burden and trends of *Acinetobacter* species throughout the DON and DOD. The EDC analyzed all outpatient and inpatient isolates among DOD beneficiaries who sought care within the Military Health System (MHS) as determined by the Medical Expense and Performance Reporting System (MEPRS) codes in microbiology data. MEPRS code of 'A' indicated isolate collection in the inpatient setting. All other MEPRS codes were considered outpatient. To estimate annual burden, all unique *Acinetobacter* species isolates per person occurring at least 30 days apart based on the CY 2014 specimen collection date were considered individual cases and retained for analysis. The first *Acinetobacter* isolate per person, per year was used to identify the annual incidence of *Acinetobacter*.

Data Collection, Processing, and Analysis

Health Level 7 (HL7) formatted microbiology data that originated from the Composite Health Care System (CHCS) at fixed military treatment facilities (MTFs) were used to identify *Acinetobacter* cases among beneficiaries seeking care at fixed MTFs. The EDC received data from the Defense Health Services Systems (DHSS) Program Executive Office of the MHS approximately two days after each record was certified. Data did not include records from purchased care providers, shipboard facilities, battalion aid stations, or in-theater facilities. Surveillance cultures, defined as specimens isolated from nares, axilla, groin, toe webs, and rectal swabs, were excluded from this analysis as surveillance cultures are typically indicative of colonization and not true infection. The EDC utilized the World Health Organization's (WHO) BacLink and WHONET applications to organize antibiotic susceptibilities within microbiology records. Microbiology data were used to identify the beneficiary's service (Air Force, Army, Marine Corps, or Navy), and the beneficiary's gender.

To determine active duty status for DON cases, the EDC matched the microbiology cases to the Defense Manpower Data Center (DMDC) active duty roster for CY 2014 using a unique patient identifier. The beneficiary status of all other beneficiaries was determined using patient category in the microbiology record. Recruits were not included as part of the active duty component for this study. DON recruits were identified separately, also using the DMDC active duty roster when a person's start of federal service date occurred during CY 2014. The end of recruit training was estimated as the start date of federal service plus 9 weeks for Navy recruits or 13 weeks for Marine recruits. Recruit cases were defined as those with a microbiology record that fell between the first day of federal service and the last day of basic training plus seven days. Seven days post end of basic training was used to ensure all *Acinetobacter* cases related to the recruit training environment were included.

To evaluate laboratory-confirmed *Acinetobacter* cases within the healthcare setting for recent healthcare exposure, the Standard Inpatient Data Record (SIDR) was matched to microbiology

records where the specimen collection date was between the admission date and up to seven days following the discharge date. Hospital-onset (HO) cases were defined as *Acinetobacter*-positive specimens collected after the third day of the admission. Healthcare-associated (HA) cases were defined as those who had a current admission with an *Acinetobacter*-positive lab result and a prior hospitalization within the previous calendar year. Community-onset (CO) cases were defined as those beneficiaries having *Acinetobacter*-positive lab results collected within the first three days of admission, indicating the patient acquired the organism within the community and likely arrived at the treating facility with the organism.[23]

Demographic and clinical information for each specimen was described using information within the HL7 microbiology record. Specimen sources of *Acinetobacter* cases were categorized by the specimen source or body site fields in the microbiology record. Blood, cerebrospinal fluid, pleural fluid, pericardial fluid, peritoneal fluid, synovial fluid, and bone were categorized as sterile sources. Skin and soft tissue infections (SSTIs) were considered specimen sources originating from wounds, abscesses, skin, lesions, pustules, cellulitis, boils, pus, carbuncles, cysts, wound drainage, wound discharge, and wound exudates. All other specimen sources were classified as non-sterile. The presentation of demographic information was limited to the first isolate per person, per year so as not to overestimate the burden rate of case demographics due to recurrent organism isolation from the same person or multiple organism isolations from the same person; clinical characteristics were presented as a proportion of all cases within the population fitting the case definition.

The EDC created an antibiogram for *Acinetobacter* species identified in 2014 using antibiotic susceptibility testing results within the HL7 microbiology record according to the Clinical and Laboratory Standards Institute (CLSI) guidelines (2009), which calls for the inclusion of the first *Acinetobacter* species isolate per person per year.[24] The EDC selected antibiotics for the antibiogram based on a 2007 report on *A. baumannii* antibiograms[25] and consultation with a subject matter expert.

Susceptibility results from the microbiology record were used to establish the level of antibiotic resistance among incident cases. Isolates that were non-susceptible (resistant or intermediately susceptible) to at least one antibiotic from at least three different antibiotic classes were considered MDR. The antibiotic classes of interest in this classification included select penicillins, cephalosporins, fluoroquinolones, and aminoglycosides. Possible XDR (PXDR) isolates were those organisms non-susceptible to some or all antimicrobials tested in an antimicrobial category but not tested against all antimicrobial categories in the definition and could therefore not be included or excluded as an XDR isolate. Organisms that were non-susceptible to at least one antibiotic in all but one or two classes of nine classes in the definition were considered XDR. Possible PDR (PPDR) isolates were those that could not be definitively identified as XDR isolates based on the XDR definition and were non-susceptible to all antibiotics tested but were not tested against all antibiotics in the definition and could therefore not be excluded as a PDR isolate. Finally, PDR organisms were organisms that were non-susceptible to all antibiotics in all antibiotic classes in the definition.[2,5,21] For the remainder of this report, unless otherwise stated, resistant and resistance are defined as *Acinetobacter* cases

having any level of antibiotic resistance, whether it be MDR, PXDR, XDR, PPDR, or PDR. See Appendix A (Table A1) for a list of antibiotics used to identify the level of resistance among cases.

HL7 formatted pharmacy records were used to identify antibiotic prescriptions presumed to be associated with *Acinetobacter* cases. The prescription data are generated in three distinct categories depending on clinical setting and route of administration: outpatient oral, inpatient oral, and intravenous (IV). For this analysis, prescriptions were presumed to be associated with an *Acinetobacter* case if the pharmacy transaction date was within seven days of the microbiology specimen collection date.

A geographic information system (GIS) map was created using ArcGIS to show the overall prevalence of *Acinetobacter* by climate region within the continental US (CONUS) and outside the CONUS (OCONUS). Organisms identified in each region act as a reservoir within that region and contribute to the burden of exposure. The US postal ZIP code of the requesting Defense Medical Information System (DMIS) identification (ID) number, an identifier unique to each MTF, in the microbiology record was used to establish the geographic location where a case originated. Each isolate was categorized into one of two groups: isolates from MTFs within the CONUS or OCONUS. The CONUS prevalence rates and the percent change in prevalence rates from CY 2013 to CY 2014 were mapped by climatic region based on the postal ZIP code of the requesting facility. Climatic regions were defined by the US Department of Energy's (DOE) Guide to Determining Climate Regions by County, 2010.[26] ZIP codes were assigned to climatic regions based on each ZIP code's average temperature and rainfall/humidity as measured by the DOE. Climatic regions were designated as hot-dry, hot-humid, marine, mixed-humid, cold, very cold, and subarctic. Climatic region prevalence rates for 2014 were calculated as the number of cases identified in each climatic region per the total MHS Data Mart (M2) beneficiary counts of all ZIP codes within the climate region. M2 is a depository of data on TRICARE eligible DOD beneficiaries. Because beneficiary counts fluctuate on a monthly basis, the EDC followed the recommendation of subject matter experts and used the beneficiary count from July of each year as an estimate for the entire year.

To provide context for CY 2014, climatic region rates were compared to CY 2013 by calculating the percent change for each region between the two years. The percent change from 2014 was determined as the difference between the rates for 2014 and 2013 divided by the 2013 rate. A map displaying the overall distribution of *Acinetobacter* cases in the DOD worldwide was created using the geographic location methodology described above. Resistant isolates were included as a percentage of all isolates occurring within a state (CONUS) or country (OCONUS).

Monthly and annual incidence rates were calculated using M2 beneficiary counts to obtain the number of TRICARE eligible beneficiaries by overall population. Beneficiary counts were retrieved monthly to calculate the monthly incidence rates. An overall percent change was used to describe annual trends in incidence from 2005 – 2014.

To provide context for 2014 incidence rates, the EDC calculated historic mean incidence rates from 2007-2013 for eligible DOD beneficiaries. The historic mean was calculated as the annual incident case count denominated by M2 beneficiary counts from 2007-2013. Monthly and quarterly rates (for 2014 and quarterly historic mean) were calculated to assess seasonality. The quarterly incidence rates were calculated as an incident case count for the three months of each quarter in each calendar year from 2007-2013 denominated by M2 beneficiary counts for each quarter from 2007-2013 for all eligible DOD beneficiaries. Monthly incidence rates were calculated as the incident case count for each month and denominated by the M2 beneficiary counts for each month.

For the DON active duty population a consistent process was established to identify unnatural variations in annual incidence rates utilizing Statistical Process Control (SPC).[27] A mean, also described as the Center Line (CL), was calculated using at least two years of data. The Upper Control Limit (UCL), known as the upper limit of natural variation, and the Lower Control Limit (LCL), known as the lower limit of natural variation, were calculated as three standard deviations above and below the mean (CL), respectively. An annual rate that falls outside of the UCL or LCL is considered to have unnatural variation. If unnatural variation occurs over several years, then the mean is reset to establish a more consistent process. For this report, the mean was reset in 2008 due to unnatural variation in *Acinetobacter* species incidence with a significant reduction in cases between 2006 and 2007 in the active duty DON population. The first mean was calculated for CY 2005 – 2007; the second mean was calculated for CY 2008 – 2013.

Results

DON/DOD

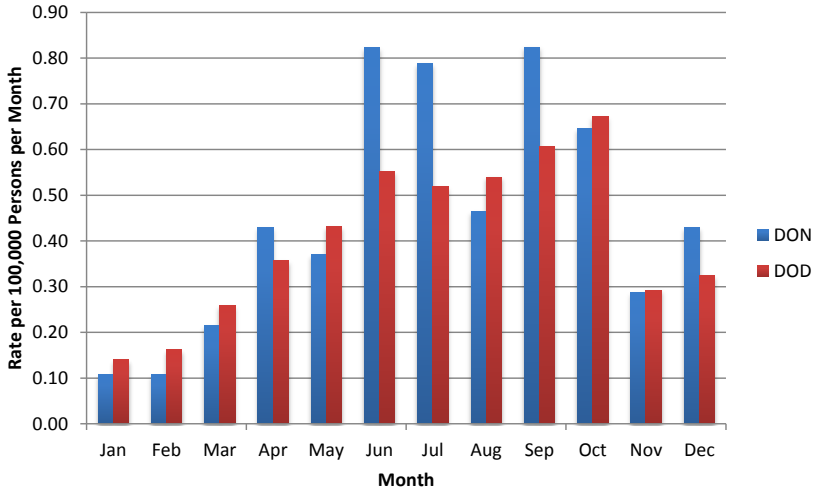
During 2014, *Acinetobacter* incidence rates in the DON and DOD were around or below the historic mean incidence rates for each quarter (Q), Q1 showing the most marked difference from the mean for both the DON and DOD. Additionally, the quarterly incidence rates reflected seasonal fluctuations with higher rates in quarter three (Table 1), when temperatures are usually higher. Figure 1 shows the monthly incidence rates for the DON and DOD beneficiary populations. The highest infection rates for both the DON and DOD occurred in the months of June through October (Q3).

Table 1. *Acinetobacter* Quarterly Incidence Rates for DON, DOD and Historic DOD Mean Incidence Rate per 100,000 Persons Per Quarter, 2014

Quarter	DON 2014	DOD 2014	DOD Historic Mean[a]
1	0.4	0.6	1.3
2	1.6	1.3	1.6
3	2.1	1.7	2.0
4	1.4	1.3	1.4

[a]Historic mean calculated as an average rate for DOD *Acinetobacter* cases from 2007-2013 by quarter.
Data are from the CHCS HL7 formatted microbiology and M2 databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 27 April 2015.

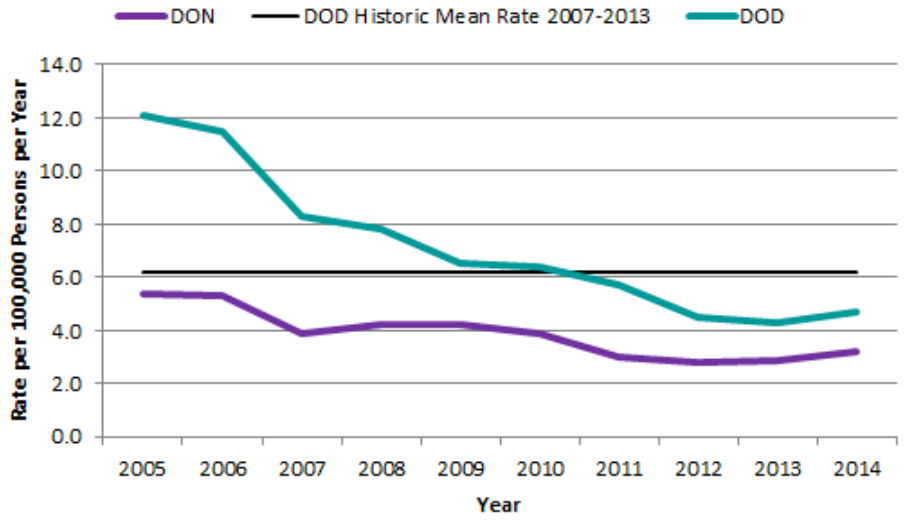
Figure 1. *Acinetobacter* Species Monthly Case Incidence Rates in Eligible DON and DOD Beneficiaries by Month, 2014



Data are from the CHCS HL7 formatted microbiology and M2 databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 27 April 2015.

Figure 2 displays the DON and DOD annual historical trends from 2007-2013. The incidence of *Acinetobacter* in the DON decreased 46.3% from 2005 to 2014, while the incidence in the DOD decreased 64.5%. The DON and DOD rates for 2014 (3.2 and 4.7 per 100,000 persons per year, respectively) were below the historic DOD mean incidence rate (6.2 per 100,000 persons per year). The 2014 rates in the DON and DOD increased slightly (about 10%) from 2013.

Figure 2. *Acinetobacter* Species Annual Incidence Rates among DON and DOD Beneficiaries, 2005-2014, with Historic Mean Incidence Rate



Historic mean incidence rate for the DOD is 6.2 per 100,000 persons per year.
Data are from the CHCS HL7 formatted microbiology and M2 databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 09 July 2015.

Table 2 shows the demographic characteristics of annual incident *Acinetobacter* cases for DON and DOD beneficiaries. A total of 148 incident *Acinetobacter* cases among DON beneficiaries and 437 among DOD beneficiaries were identified. For both the DON and DOD, the highest incidence rates occurred in men, active duty service members, beneficiaries between the ages of 18 and 24, and OCONUS. Marine Corps beneficiaries had the highest *Acinetobacter* incidence rate, with a rate almost twice that of Navy beneficiaries. The active duty beneficiary rate was also at least two times higher than any other beneficiary category; trends were similar to CY 2013.

Table 2. Demographics of *Acinetobacter* Incidence in the DON and DOD, CY 2014

DON			DOD		
N = 148	**Count**	**Rate[a]**	**N = 437**	**Count**	**Rate[a]**
Gender			**Gender**		
Female	61	4.5	Female	194	4.3
Male	87	6.0	Male	243	5.2
Age Group			**Age Group**		
0-17 years	30	5.3	0-17 years	96	5.0
18-24 years	46	10.7	18-24 years	89	7.6
25-34 years	21	5.9	25-34 years	70	5.9
35-44 years	10	4.1	35-44 years	34	4.2
45-64 years	18	2.9	45-64 years	69	3.4
65+ years	23	3.9	65+ years	79	3.7
Sponsor Service			**Sponsor Service**		
			Air Force	82	3.2
			Army	207	5.3
Marine Corps	59	7.9	Marine Corps	59	7.9
Navy	89	4.3	Navy	89	4.3
Beneficiary Type			**Beneficiary Type**		
Active duty	54	10.4	Active duty	118	8.6
Family member	65	4.2	Family member	218	7.1
Retired	25	4.0	Retired	87	4.2
Other	4	*N/R*[b]	Other	14	1.6
Location			**Location**		
CONUS	129	5.5	CONUS	392	4.5
OCONUS	19	18.8	OCONUS	45	12.0
Unknown[b]	0		Unknown[c]	0	

[a]Rates per 100,000 eligible beneficiaries in each demographic category.
[b]Rates for Incident case counts of <5 were considered insignificant and not-reportable (*N/R*).
[c]TRICARE service region cannot be identified from the microbiology record.
Data are from the CHCS HL7 formatted microbiology and M2 databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 24 April 2015.

In CY 2014, 33 CONUS states and 1 US territory had *Acinetobacter* cases identified; OCONUS locations in Japan, United Kingdom, Germany, Italy, and Turkey also had *Acinetobacter* cases identified among beneficiaries stationed and/or living in those countries. Ten states, plus Japan and Germany had MDR cases identified. Only two states (Maryland and California) had higher-level resistance (PXDR and XDR, respectively) identified (Figure 3).

Figure 3. Distribution of *Acinetobacter* Burden and Percentage of Multidrug-Resistant Cases in the DOD, CY 2014

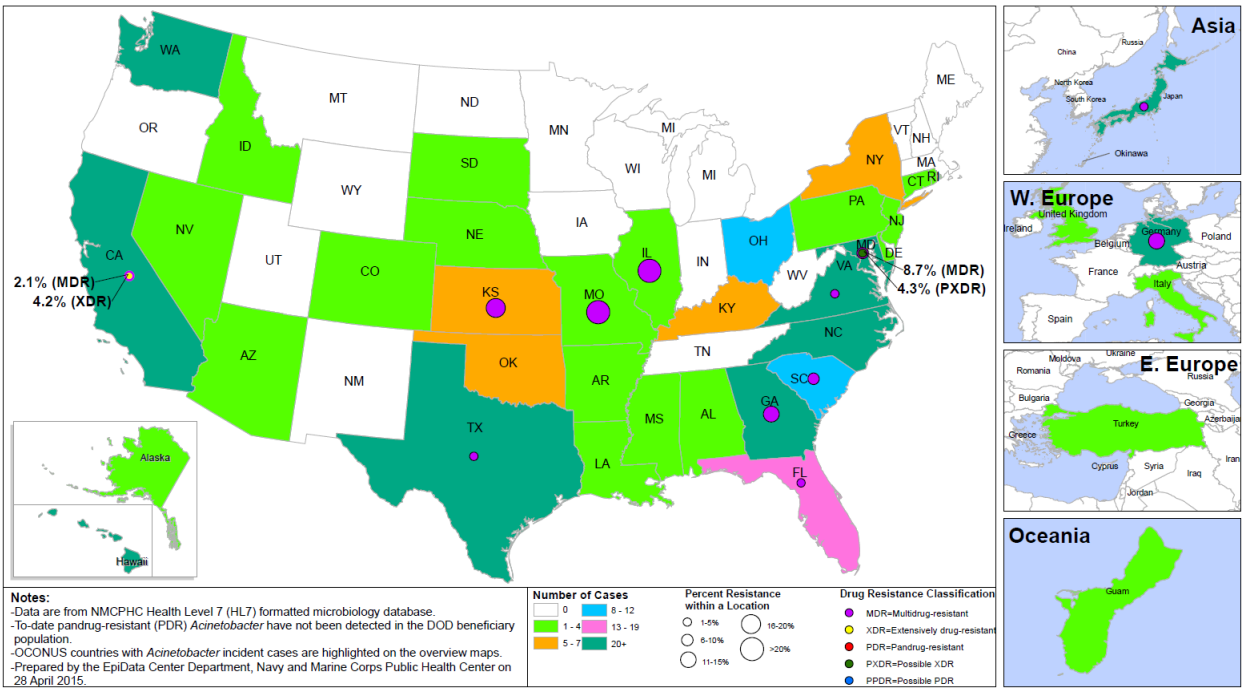


Table 3 displays the clinical characteristics of all *Acinetobacter* species cases in the DON and DOD for 2014. Most isolates were collected in the outpatient setting and from non-sterile body sites, indicative of non-invasive infection. The most common causative agent of *Acinetobacter* cases was *Acinetobacter* species not otherwise specified (NOS) (33.1% and 30.7% in the DON and DOD, respectively). In the DON, 2.6% of *Acinetobacter* isolates were MDR and 1.3% were XDR. In the DOD, 5.3% of cases were MDR and 0.4% were XDR.

Of the 148 unique DON beneficiaries, 5 beneficiaries had more than 1 laboratory-confirmed *Acinetobacter* case and accounted for 11 cases; none of the beneficiaries with multiple cases were MDR cases (data not shown). Nine people accounted for 21 *Acinetobacter* cases in the DOD; 4 of the 21 cases were MDR, all from the same person, while the remaining 17 cases did not exhibit any level of resistance (data not shown).

There were 22 hospitalizations with *Acinetobacter* in the DON in 2014. Two (9.5%) of the 22 hospitalizations were HA cases and 3 (14.3%) were an HO case, while 17 hospitalizations (76.2%) were CO cases. The DOD had 56 hospitalizations with *Acinetobacter* in 2014. Five (8.5%) of these 56 hospitalizations were HA cases and 6 (10.2%) were HO cases, while 48 hospitalizations (81.4%) were CO cases.

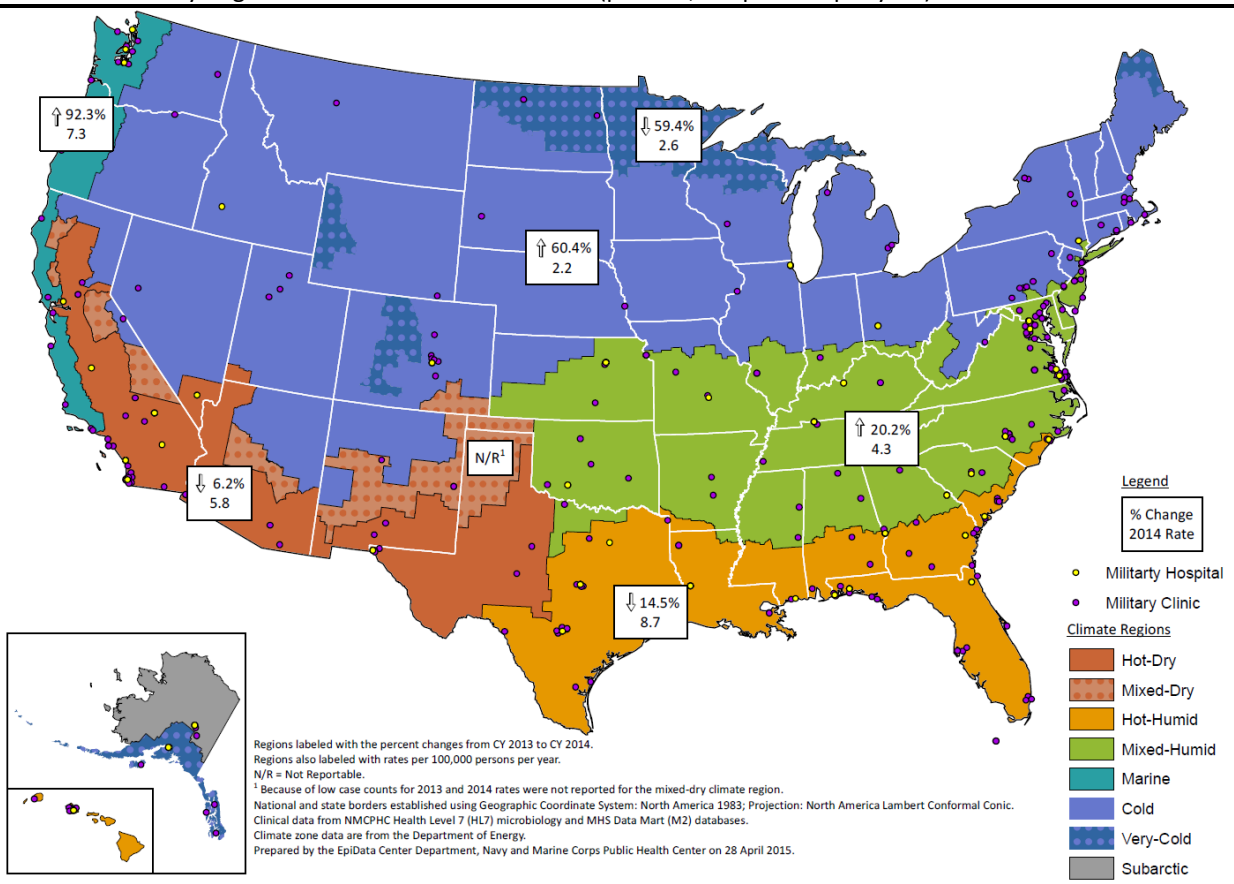
Table 3. Clinical Description of *Acinetobacter* Species Burden in the DON and DOD, CY 2014

DON			DOD		
N = 154	**Count**	**Percent**	**N = 449**	**Count**	**Percent**
Encounter Type			**Encounter Type**		
Outpatient	132	85.7	Outpatient	393	87.5
Inpatient	22	14.3	Inpatient	56	12.5
Healthcare Association [a,c]			**Healthcare Association** [b,c]		
Community onset (CO)	17	81.0	Community onset (CO)	48	81.4
Healthcare associated (HA)	2	9.5	Healthcare associated (HA)	5	8.5
Hospital onset (HO)	3	14.3	Hospital onset (HO)	6	10.2
Infection Type			**Infection Type**		
Non-sterile	92	59.7	Non-sterile	256	57.0
Skin and soft tissue infections (SSTI)	56	36.4	Skin and soft tissue infections (SSTI)	176	39.2
Sterile	6	3.9	Sterile	17	3.8
Species			**Species**		
A. baumannii	35	22.7	*A. baumannii*	89	19.8
Acinetobacter species, NOS	51	33.1	*Acinetobacter* species, NOS	138	30.7
A. calcoaceticus-baumannii complex	36	23.4	*A. calcoaceticus-baumannii* complex	128	28.5
A. lwoffii	22	14.3	*A. lwoffii*	63	14.0
A. calcoaceticus	6	3.9	*A. calcoaceticus*	22	4.9
A. hemolyticus	1	0.6	*A. hemolyticus*	5	1.1
A. junii	3	1.9	*A. junii*	4	0.9
A. johnsonii	0	--	*A. johnsonii*	0	--
A. anitratus	0	--	*A. anitratus*	0	--
Multidrug-Resistance			**Multidrug-Resistance**		
Multidrug (MDR)	4	2.6	Multidrug (MDR)	24	5.3
Possible Exensively Drug (PXDR)	1	0.6	Possible Exensively Drug (PXDR)	1	0.2
Extensively drug (XDR)	2	1.3	Extensively drug (XDR)	2	0.4
Possible Pandrug (PPDR)	0	--	Possible Pandrug (PPDR)	0	--
Pandrug (PDR)	0	--	Pandrug (PDR)	0	--
None[d]	147	95.5	None[d]	422	94.0

[a]Percentage of DON hospitalizations (N = 22).
[b]Percentage of DOD hospitalizations (N = 56).
[c]A single *Acinetobacter* isolate can be classified as more than one healthcare-associated exposure, therefore counts in this category may exceed the total N for the population.
[d]No level of multidrug-resistance (MDR, PXDR, XDR, PPDR, or PDR) was detected.
Data are from the CHCS HL7 formatted microbiology, SIDR, and M2 databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 24 April 2015.

The incidence rates of *Acinetobacter* cases identified in 2014 was compared to the 2013 rates for each climate region. Rates of *Acinetobacter* cases increased in the marine, mixed-humid, and cold regions and decreased in the hot-humid, hot-dry, and very-cold/subarctic regions. The highest regional 2014 incidence rates occurred in the hot-humid climate region; the lowest occurred in the cold climate region. The largest change in 2014 occurred in the marine climate region with an increase of 92.3% from 2013 and the very-cold/subarctic climate region with a 59.4% decrease from 2013 (Figure 4).

Figure 4. CONUS Climate Region Distribution and Percent Change of *Acinetobacter* Incidence from CY 2013 to CY 2014 in the DOD by Region with Annual Incidence Rates (per 100,000 persons per year)



Trimethoprim/sulfamethoxazole was overall the most commonly prescribed antibiotic in the DON for *Acinetobacter* cases that was not resistant; ciprofloxacin was the second-most commonly prescribed antibiotic. Trimethoprim/sulfamethoxazole was the most commonly prescribed oral antibiotic while piperacillin/tazobactam and ceftriaxone were the most commonly prescribed IV antibiotics. Table 4 includes a list of the most common DON prescriptions for non-multidrug resistant *Acinetobacter* cases. Regardless of the route of administration, cefazolin was the most commonly prescribed antibiotic in the DON for resistant *Acinetobacter* cases (data not shown).

Table 4. Antibiotic Prescriptions for Non-Multidrug Resistant *Acinetobacter* Species Cases in the DON, CY 2014

Class	Oral (N = 111)		Intravenous (N = 28)		Most Frequent in Class (Regardless of Route of Administration)	Within Class	
	Count	Percent	Count	Percent	Antibiotic Name	Count	Percent
Fluoroquinolones	35	31.5%	9	32.1%	Ciprofloxacin	26	59.1%
Sulfonamides	32	28.8%	0	0.0%	Trimethoprim/Sulfamethoxazole*	32	100.0%
Penicillins and Inhibitors	14	12.6%	6	21.4%	Piperacillin/Tazobactam	11	55.0%
Lincosamides	11	9.9%	1	3.6%	Clindamycin*	12	100.0%
Tetracyclines	10	9.0%	0	0.0%	Doxycycline	7	70.0%
Macrolides	7	6.3%	2	7.1%	Azithromycin	7	77.8%
Cephalosporins	0	0.0%	7	25.0%	Ceftriaxone*	5	100.0%
Aminoglycosides	1	0.9%	2	7.1%	Gentamicin	2	66.7%
Carbapenems	1	0.9%	1	3.6%	Meropenem*	2	100.0%

N = Number of cases with at least one antibiotic of that type (oral or intravenous).
*Only antibiotic in class prescribed.
Data are from the CHCS HL7 formatted pharmacy databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 09 July 2015.

Regardless of the route of administration, trimethoprim/sulfamethoxazole was the most commonly prescribed antibiotic in the DOD for *Acinetobacter* cases that was not resistant; ciprofloxacin was the second-most commonly prescribed antibiotic (data not shown). Trimethoprim/sulfamethoxazole was the most commonly prescribed oral antibiotic while ceftriaxone and piperacillin/tazobactam were the most commonly prescribed IV antibiotics (Table 5). For DOD resistant isolates, the most commonly prescribed antibiotics, regardless of the route of administration, were ciprofloxacin and trimethoprim/sulfamethoxazole (data not shown).

Table 5. Antibiotic Prescriptions for Non-Multidrug Resistant *Acinetobacter* Species Cases in the DOD, CY 2014

Class	Oral (N = 294)		Intravenous (N = 74)		Most Frequent in Class (Regardless of Route of Administration)	Within Class	
	Count	Percent	Count	Percent	Antibiotic Name	Count	Percent
Fluoroquinolones	101	34.4%	18	24.3%	Ciprofloxacin	55	46.2%
Sulfonamides	80	27.2%	0	0.0%	Trimethoprim/Sulfamethoxazole*	80	100.0%
Lincosamides	38	12.9%	4	5.4%	Clindamycin*	42	100.0%
Penicillins and Inhibitors	30	10.2%	16	21.6%	Piperacillin/Tazobactam	24	52.2%
Cephalosporins	4	1.4%	23	31.1%	Ceftriaxone	17	63.0%
Tetracyclines	22	7.5%	0	0.0%	Doxycycline	18	81.8%
Macrolides	16	5.4%	3	4.1%	Azithromycin	16	84.2%
Carbapenems	1	0.3%	7	9.5%	Meropenem	5	62.5%
Aminoglycosides	1	0.3%	3	4.1%	Gentamicin	3	75.0%
Polymyxins	1	0.3%	0	0.0%	Polymyxin B*	1	100.0%

N = Number of cases with at least one antibiotic of that type (oral or intravenous).
*Only antibiotic in class prescribed.
Data are from the CHCS HL7 formatted pharmacy databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 09 July 2015.

Table 6 displays an antibiogram of *Acinetobacter* species for DON and DOD beneficiaries. DON *Acinetobacter* species were most susceptible to gentamicin (96.3%) followed by tobramycin (95.3%), and least susceptible to ceftriaxone (40.0%). DOD *Acinetobacter* species were most susceptible to gentamicin (96.8%) followed by amikacin (96.5%), and least susceptible to nitrofurantoin (5.9%).

Table 6. Antibiogram of DON and DOD *Acinetobacter* Species Isolates, CY 2014

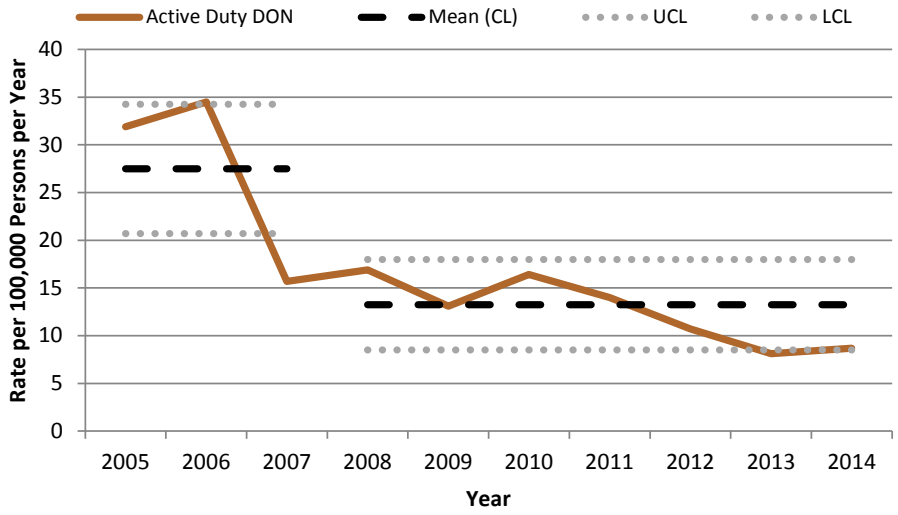
Population			Amikacin	Amoxacillin/ Clavulanate	Ampicillin	Ampicillin/ Sulbactam	Cefepime	Cefotaxime	Ceftazidime	Ceftriaxone	Ciprofloxacin	Gentamicin	Imipenem	Levofloxacin	Meropenem	Nitrofurantoin	Piperacillin	Pipperacillin/ Tazobactam	Tetracycline	Tobramycin	Trimethoprim/ Sulfamethoxazole
DON	N = 148	% Susceptible	93.9	--	--	90.8	89.5	--	84.0	40.0	92.9	96.3	94.2	92.6	--	--	--	--	90.0	95.3	91.2
		# Tested[a]	49			76	95		94	75	126	135	86	94					30	85	102
DOD	N = 437	% Susceptible	96.5	57.9	14.1	93.0	87.8	59.5	79.4	42.1	93.5	96.8	94.7	95.7	88.9	5.9	73.3	89.1	88.3	95.7	91.4
		# Tested[a]	172	38	64	201	270	79	287	240	382	400	225	280	54	34	75	64	111	256	315

[a]Only antibiotics with ≥30 isolates tested were reported.
Data are from the CHCS HL7 formatted microbiology database.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 04 May 2015.

DON Active Duty

Overall, for 2014, DON active duty service members had an *Acinetobacter* incidence rate of 8.7 per 100,000 DON active duty service members per year. The active duty analysis excluded any service members who were identified as recruits. The 2014 rate was a slight increase (7.4% change) from the 2013 rate (8.1 per 100,000 active duty service members per year). Figure 5 shows an overall descending trend in incidence among DON active duty service members from 2005-2014 (percent change = 74.6%). The 2014 rate is 38.6% below the new CL for 2008-2013 (13.2 per 100,000 active duty service members per year) but still above the LCL (8.5 per 100,000 active duty service members per year) and therefore considered natural variation.

Figure 5. *Acinetobacter* Species Incidence Rates among Active Duty DON Service Members with Historic Mean Incidence Rate, 2005-2014



Historic means were calculated as the sum of *Acinetobacter* cases per year divided by the sum of M2 eligible beneficiaries per year for 2005-2007 and 2008-2013.
Data are from the CHCS HL7 formatted microbiology and M2 databases and the DMDC active duty roster.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 05 May 2015.

Table 7 shows the demographic incidence rates for active duty DON personnel with *Acinetobacter* cases in 2014. Active duty Marines had a rate about one and a half times as high as their Navy counterparts. Additionally, active duty females had a rate also about one and a half times higher than that of males. Other demographic categories displaying the highest incidence were service members between the ages of 18 and 24 and OCONUS MTF locations.

Table 7. Demographics of DON Active Duty *Acinetobacter* Species Incidence, CY 2014

N = 45	Count	Rate[a]
Gender		
Female	9	12.4
Male	36	8.1
Age Group		
18-24 years	32	13.8
25-34 years	10	5.2
35-44 years	2	*N/R*[b]
45-64 years	1	*N/R*[b]
65+ years	0	--
Sponsor Service		
Marine Corps	21	11.0
Navy	24	7.3
Location		
CONUS	40	9.0
OCONUS	5	9.8

[a]Rates per 100,000 DON active duty service members per year in each demographic category for each service.
[b]Rates for case counts <5 are considered insignificant and not-reportable (*N/R*).
Data are from the HL7 formatted microbiology and M2 databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 05 May 2015.

Table 8 shows the clinical characteristics of DON active duty *Acinetobacter* cases. Overall, organisms were primarily identified in the outpatient setting and from SSTIs. Three DON active duty service members (6.7%) with *Acinetobacter* were hospitalized in CY 2014. Two (50.0%) of these hospitalizations were HO cases, while the remaining two (50.0%) were CO cases. The *Acinetobacter* species, NOS were isolated most often (35.6%) among active duty DON service members. Only one *Acinetobacter* case was classified as MDR; the remaining 44 cases were not resistant. Surveillance identified no PDR cases.

Table 8. Clinical Description of Active Duty *Acinetobacter* Species Burden in the DON, CY 2014

N = 45	Count	Percent
Encounter Type		
Outpatient	41	91.1
Inpatient	4	8.9
Healthcare Association[a,b]		
Community onset (CO)	2	50.0
Healthcare associated (HA)	0	0.0
Hospital onset (HO)	2	50.0
Infection Type		
Skin and Soft Tissue Infection (SSTI)	24	53.3
Non-sterile	21	46.7
Sterile	0	0.0
Species		
Acinetobacter species, NOS	16	35.6
A. baumannii	8	17.8
A. calcoaceticus-baumannii complex	10	22.2
A. lwoffii	7	15.6
A. calcoaceticus	3	6.7
A. hemolyticus	1	2.2
A. junii	0	--
A. johnsonii	0	--
A. anitratus	0	--
Multidrug-Resistance		
Multidrug (MDR)	1	2.2
Possible Extensively Drug (PXDR)	0	--
Extensively drug (XDR)	0	--
Possible Pandrug (PPDR)	0	--
Pandrug (PDR)	0	--
None[c]	44	97.8

[a]Percentage per number of inpatient cases (N = 3).
[b]A single *Acinetobacter* isolate can be classified as more than one healthcare-associated exposure, therefore counts in this category may exceed the total N.
[c]No level of multidrug resistance (MDR, PXDR, XDR, PPDR, or PDR) was detected.
Data are from the HL7 formatted microbiology, SIDR, and M2 databases.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 05 May 2015.

DON Recruits

The annual incidence of *Acinetobacter* among DON recruits was 18.3 per 100,000 recruits per year in CY 2014. Table 9 presents the demographics of DON recruit *Acinetobacter* cases. The majority of DON recruit cases occurred among Marines with an incidence rate of 34.5 per 100,000 Marine recruits per year; the Navy recruit rate was not reportable (N/R). The highest rates occurred among male recruits and recruits between the ages of 16 and 24.

Table 9. Demographics of DON Recruit *Acinetobacter* Species Incidence, CY 2014

N = 12	Count	Rate[a]
Gender		
Female	1	*N/R*[b]
Male	11	20.4
Age Group		
16-24 years	11	17.9
25-34 years	1	*N/R*[b]
Sponsor Service		
Marine Corps	10	34.5
Navy	2	*N/R*[b]

[a]Rates per 100,000 DON recruits per year.
[b]Rates for case counts <5 are considered insignificant and not-reportable (*N/R*).
Data are from the CHCS HL7 formatted microbiology database and the DMDC active duty roster.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 24 April 2015.

Table 10 displays the clinical characteristics of *Acinetobacter* species isolated among DON recruits. All isolates were collected in the outpatient setting, primarily from SSTI specimen sources. *Acinetobacter* species NOS were the most common species isolated. No resistant *Acinetobacter* cases were identified among DON recruits in 2014 and no DON recruits were identified as cases associated with the healthcare setting in CY 2014.

Table 10. Clinical Description of DON Recruit *Acinetobacter* Species Burden in the DON, CY 2014

N = 12	Count	Percent
Encounter Type		
Outpatient	12	100.0
Inpatient	0	--
Infection Type		
Skin and Soft Tissue Infections (SSTI)	8	66.7
Non-sterile	4	33.3
Sterile	0	--
Species		
A. baumannii	4	33.3
Acinetobacter species NOS	5	41.7
A. calcoaceticus-baumannii complex	2	16.7
A. calcoaceticus	1	8.3
A. lwoffii	0	--
A. hemolyticus	0	--
A. junii	0	--
A. johnsonii	0	--
A. anitratus	0	--
Antibiotic Resistance		
Multidrug (MDR)	0	--
Possible Extensively drug (PXDR)	0	--
Extensively drug (XDR)	0	--
Possible Pandrug (PPDR)	0	--
Pandrug (PDR)	0	--
None[a]	12	100.0

[a]No level of multidrug resistance (MDR, PXDR, XDR, PPDR, or PDR) was detected.
Data are from the CHCS HL7 formatted microbiology database, SIDR database, and the DMDC active duty roster.
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 24 April 2015.

Discussion

The incidence rate of *Acinetobacter* in the DON and DOD beneficiary populations rose slightly in 2014 yet remained below the historic mean incidence rate from 2007-2013. Even so, this increase was not large enough to be considered outside of the normal variation. This report suggests that recent *Acinetobacter* incidence follows previously observed disease dynamics within the DON and DOD. Monthly and quarterly incidence rates in the DON and DOD display the expected seasonality of *Acinetobacter* species, with the summer and fall months coinciding with the highest incidence rates.

Climate and seasonality are both important factors in the propagation of *Acinetobacter*, which flourishes in warm, humid environments.[3,5-7] The CONUS rates by climatic region clearly show that regions with high heat and/or humidity had the highest incidence. The greatest change was a 92.3% increase in the marine climate region, though the highest rate was in the hot-humid region, neither of which is surprising given the environmental conditions experienced in those locations. The distribution of cases in the CONUS and OCONUS followed normal patterns with the highest case counts in locations with the largest beneficiary populations and at a density consistent with previous observations. Overall, *Acinetobacter* cases in the DOD aligned with the normal variability of the organism and followed typical geographical and seasonal patterns.

The burden among Marine Corps beneficiaries was higher than the burden for all other service beneficiary groups across all populations in 2014, as was also reported previously in 2013. More in depth analysis of Marine Corps beneficiary cases showed the distribution of case demographics was highly skewed toward higher rates among active duty service members and those between the ages of 18 and 24; all consistent with 2013 observations. Of note however, is that the 2014 Marine Corps disparity was smaller in magnitude than it was in 2013. Further analysis has shown that though the incidence among Sailors and Marines seems quite different given the disparity between the magnitudes of their respective rates, there is statistically no difference between the populations. Therefore, it can be concluded that the prevalence of active duty Sailors and Marines are similar and not disproportionately affecting one population, and that the difference is decreasing.

Acinetobacter resistance to multiple antibiotics remains relatively low as only 3.9% of DON cases had any level of resistance, a decrease from previous years. DON active duty service members accounted for only one of the MDR cases. Previous reports showed that deployment-related cases tend to be more resistant than active duty non-deployment related cases. It is therefore not surprising that cases among DON active duty service members in 2014, none of which were deployment-related, displayed a low prevalence of resistance. Antibiotic susceptibilities for *Acinetobacter* within the DOD and DON show that treatment options for *Acinetobacter* remain relatively unchanged. However, for most antibiotics, an increase in susceptibility was noted and none more pronounced than ciprofloxacin, which, according to CLSI guidelines,[25] demonstrated a statistically significant increase in susceptibility, from 2013-2014.

Among all beneficiaries, the burden of *Acinetobacter* remains largely with OCONUS beneficiaries for both the DON and DOD. Even though the number of cases is higher in the CONUS, the incidence rate is a little over three times higher OCONUS. This phenomenon is consistent with observations from 2013 where the burden was primarily OCONUS as well; continuing the divergence from historical observations. Therefore, the shift noted in 2013 was not an isolated event and may be beginning a new disease dynamic. It further demonstrates that the change seen in 2013 was likely more than a random fluctuation in case burden. Continued surveillance is needed to confirm this emerging trend with subsequent years of data. Also consistent with 2013 observations, and historic observations from 2005-2012 indicating a steadily increasing number of CO cases, around 80.0% of cases identified in the healthcare setting in 2014 were CO, meaning that the vast majority of cases were unrelated to contact with MTFs. Purchased care contact could not be evaluated with available data sources; therefore, a portion of these cases may be HA but were misclassified as a result of the lack of purchased care data. However, given only 14.3% of all cases were inpatient cases, any reclassification of cases as HA would not change the fact that the majority of cases still come from the community setting. The perpetuation of 2013 trends, as OIF/OEF combat deployment activity continues to drawdown, further emphasizes the potential existence of a baseline of *Acinetobacter* incidence within CONUS prior to activity related to OIF/OEF. This evidence lends credence to the previously suggested notion that community reservoirs might exist and could be evidence of a change in epidemiology of *Acinetobacter* within the MHS to something more closely related to the pre-war baseline. Continued changes in operational tempo and subsequently a reduction in the risk of acquiring novel, highly resistant strains of *Acinetobacter*, reduces the overall risk. With a reduced risk to active duty personnel, there is also a reduced risk of spreading novel, highly resistant strains within MTFs, the DOD, and general US population at large. Continued monitoring is necessary to confirm these emerging trends.

There was an overall descending trend of *Acinetobacter* incidence in DON active duty service members from 2005-2014. The descending trend is likely the reflection of one or a combination of the following: a better understanding of the epidemiology of *Acinetobacter* (primarily among deployed service members), the development of standard infection control and treatment practices for combat-related infections, and changes in operational tempo of OIF/OEF, as well as the drawdown of service members deployed to the US Central Command (CENTCOM) area of responsibility. Much of this understanding was established in the mid-2000s and recommendations/changes resulting from that understanding likely resulted in the drastic drop in active duty cases observed between 2006 and 2007.[19] Hence, this is why SPC method was used to reset the mean from 2008 onward. The fact that 2014 is still within the lower limit of natural variation suggests that the new trend established in the late-2000s is still being experienced today. The active duty incidence rate for 2013 was below the LCL; it was not low enough however to indicate a concerning deviation from natural variation. If the active duty incidence continues to decline, as has been the recent trend, a new baseline may need to be set as the active duty population vacates areas of risk for exposure to *Acinetobacter* because of continuing changes in operational tempo and areas of operation.

Female active duty DON service members experienced a higher burden than their male

counterparts in 2014, consistent with previous observations. The case count between the two groups however, shows that males have a higher case count and account for 80.0% of all DON active duty cases. Yet, females have an incidence rate 1.5 times that of active duty males, while accounting for only 20.0% of overall incident cases. With such a small case count, further stratification of female active duty cases provided no insight as to the potential cause for the higher rate. Continued close monitoring of active duty females is recommended to monitor the situation for any novel patterns.

The majority of DON *Acinetobacter* cases in recruits occurred among Marine recruits between the ages of 16 and 24, which is the predominant age group in recruit training. Both Marine Corps Recruit Depots (MCRDs) are located in warm areas of the US (South Carolina and southern California), which present conditions favorable to the growth of *Acinetobacter* species. As such, the higher prevalence among Marine recruits can partially be attributed to the climatic conditions associated with the locations of the MCRDs. Another contributing factor to the high Marine recruit burden could be related to the unique environmental conditions associated with recruit training, as well as the longer training period for Marine recruits. The Naval Training Center is located in Great Lakes, Illinois, which experiences, on average, a cooler and less humid climate than the MCRDs and may be a reason why the DON identified very few cases of *Acinetobacter* among Navy recruits. No DON recruit case displayed any level of resistance, which has been the normal trend in this population; this makes the previous occurrence of a single MDR case in 2013 an isolated event, confirming that resistance is not a current concern in this population. However, continued monitoring of recruits should provide situational awareness of any emergent infections and drug resistance.

This annual report summarized *Acinetobacter* species incidence and burden in the DON and DOD beneficiary populations in 2014 and reported changes and consistent emerging patterns from previously identified trends. Given this organism's evolving resistance, ability to take up resistance determinants from the environment, and historical association with deployment-related infections, it is important to monitor and manage the risk to the DOD population at large. Therefore, continued surveillance of *Acinetobacter* is necessary to monitor and document any changes in burden and drug resistance.

Limitations

HL7 formatted data are generated within the CHCS at fixed MTFs. Microbiology testing results only list the organism(s) that were identified, not the intended tests (e.g., if a physician suspects an organism different from the one that was identified, the record will not show the organism that the physician suspected). Microbiology data were used to identify laboratory confirmed cases of illness. However, the microbiology data does not capture cases in which a physician chose to treat presumptively without laboratory confirmation. Clinical practices also vary among providers and facilities. For example, some clinicians may not perform cultures for confirmatory tests for patients with influenza-like illness symptoms or for patients with superficial infections who were treated presumptively. Therefore, the isolate counts here are likely an underestimate of the actual burden of *Acinetobacter* species in the DOD.

The use of microbiology data for analysis of antibiotic resistance was limited by the practice of cascade reporting, where antibiotic sensitivity results are conditionally reported to CHCS to guide treatment decisions. DOD MTFs practice cascade reporting to varying degrees. Furthermore, not all laboratories in the DOD operate under the same version of CLSI guidelines. As a result, certain facilities use guidelines with outdated antibiotic susceptibility breakpoints and may incorrectly report some susceptibilities. Thus, the EDC cannot project a complete picture of the susceptibility patterns for *Acinetobacter* species isolates and the presumption of reduced susceptibility is applied to all antibiotics in a class if an isolate is shown to be resistant to that class.

Rate calculations based on climatic region were limited by the availability of denominators. To provide meaningful rates, climate regions were grouped around ZIP codes, which do not necessarily align with available climate data from the Department of Energy, which is provided by county. Each state was grouped into the climatic region that was occupied by the majority of the ZIP code that was in a county, thus slightly altering the true climatic distribution of cases within the US. The climatic rates and percent changes therefore slightly vary from the true climatic rate. However, these modifications were few and the variation from the true rate is therefore minimal. These rates were a reflection of burden within a climatic region, not exposure as available data only points to the location of organism identification not organism exposure or acquisition. Furthermore, deployment-related cases were not removed from the calculations and affect the ability to relate the reported rates to exposure.

A SIDR is created at discharge or transfer from an inpatient MTF for all TRICARE beneficiaries. For active duty personnel, this occurs for non-military medical treatment facility discharges as well. Data for medical surveillance are considered provisional and medical case counts may change if the discharge record is edited after the patient is discharged from the MTF. As this report presents an annual summary and several months were allotted in the new year to account for possible data lag and record corrections, it can be presumed with relative certainty that the records identified are the final and complete records for an inpatient encounter; however, the possibility does exist that records still may be modified, thereby altering case counts.

DMDC stores data on service members using multiple rosters. The active duty roster contains all active duty service members and should include activated reservists. However, anecdotal analyses conducted by the EDC suggest that not all activated reservists are listed on the active duty roster. Additionally, DMDC records are created only once a month. If a reservist was activated after his or her record was created, the record would not reflect the change in status until the following month. While this is the exception and not the standard for DMDC records, identification of active duty service members is incomplete as a result.

Providers may not have prescribed the antibiotics in response to the *Acinetobacter* infection. It is possible that antibiotics dispensed around the same timeframe of *Acinetobacter* culture reflects treatment for other reasons. Additionally, cases where a physician chose to treat presumptively were not captured because HL7 microbiology records were used to define cases. Because only *Acinetobacter* species isolates were identified, this analysis did not afford the opportunity to consider if patients had a concurrent infection with another organism for which a prescribed antibiotic could have alternatively been intended. However, the majority of antibiotics prescribed were antibiotics that could be used in the treatment of an *Acinetobacter* infection, suggesting that the isolate was the intended target for the antibiotic prescription.

All the above mentioned databases are limited in that they do not include data from purchased care providers, shipboard facilities, battalion aid stations, or in-theater facilities. Therefore, these results are only an estimate of the true *Acinetobacter* species burden in the DON and DOD. In addition, this report did not consider deployment exposure and the proportion of cases imported from outside the treating MTF's geographic area is unknown, though this number is believed to be decreasing.

Appendix A

Table 11. Antibiotic Classes Used to Identify the Level of Multidrug Resistance in *Acinetobacter* Species[a]

Antibiotic Classes	Antibiotic
Aminoglycosides	Gentamicin
	Tobramycin
	Amikacin
	Netilmicin
Antipseudomonal carbapenems	Imipenem
	Meropenem
	Doripenem
Antipseudomonal fluoroquinolones	Ciprofloxacin
	Levofloxacin
Antipseudomonal penicillins & β-lactamase inhibitors	Piperacillin/Tazobactam
	Ticarcillin/Clavulanic acid
Extended-spectrum cephalosporins	Cefotaxime
	Ceftriaxone
	Ceftazidime
	Cefepime
Folate pathway inhibitors	Trimethoprim/Sulfamethoxazole
Penicillins & β-lactamase inhibitors	Ampicillin/Sulbactam
Polymyxins	Colistin
	Polymyxin B
Tetracyclines	Tetracycline
	Doxycycline
	Minocycline

Multidrug-resistant (MDR): non-susceptible to ≥1 antibiotic in ≥3 antimicrobial categories.
Extensively drug-resistant (XDR): non-susceptible to ≥1 antibiotic in all but 1 or 2 antimicrobial categories.
Pandrug-resistant (PDR): non-susceptible to all antibiotics listed.
[a]Table modified from Magiorakos et al., 2012.[21]
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 14 August 2014.

References

1. Blossom D, Srinivasan A. Drug-resistant *Acinetobacter baumannii-calcoaceticus* complex: an emerging nosocomial pathogen with few treatment options. *Infect Dis Clin Pract.* 2008;16(1):1-3.
2. Peleg A, Seifert H, Patterson D. *Acinetobacter baumannii*: emergence of a successful pathogen. *Clin Microbiol Rev.* 2008;21(3):538-582.
3. Gerner-Smidt P, Tjernberg I, Ursing J. Reliability of phenotypic tests for identification of *Acinetobacter* species. *J Clin Microbiol.* 1991;29:277-282.
4. Munoz-Prince S, Weinstein R. *Acinetobacter* infection. *N Engl J Med*. 2008; 358(12):1271-1281.
5. Manchanda V, Sinha S, Singh NP. Multidrug resistant *Acinetobacter*. *J Glob Infect Dis*. 2010;2(3):291-304.
6. Perez F, Hujer AM, Hujer KM, et al. Minireview: global challenge of multi-drug resistant *Acinetobacter baumannii*. *Antimicrob Agents Chemother*. 2007;15(10):3471-3484.
7. McDonald LC, Banerjee SN, Jarvis WR, and the National Nosocomial Infectious Surveillance System. Seasonal variation of *Acinetobacter* infections: 1987-1996. *Clin Infect Dis*. 1999;29:1133-1137.
8. Baumann P, Doudoroff M, Stanier RY. A study of Moraxella group II: oxidative-negative species (genus *Acinetobacter*). *J Bacteriol*. 1968;95:1520-1541.
9. Fournier PE, Richet H. The epidemiology and control of *Acinetobacter baumannii* in health care facilities. *Clin Infect Dis*. 2006;42:692-699.
10. Towner KJ. *Acinetobacter*: an old friend, but new enemy. *J Hosp Infect.* 2009;73:355-363.
11. Eveillard M, Kempf M, Belmonte O, Pailhories H, Joly-Guillou ML. Reservoirs of *Acinetobacter baumannii* outside the hospital and potential involvement in emerging human community-acquired infections. *Int J Infect Dis.* 2013. In print: http://dx.doi.org/10.1016/j.ijid.2013.03.021.
12. Sebeny PJ, Riddle MS, Petersen K. *Acinetobacter baumannii* skin and soft-tissue infection associated with war trauma. *Clin Infect Dis*. 2008;47:444-449.
13. Howard A, O'Donoghue M, Freeney A, Sleator RD. *Acinetobacter baumannii:* an emerging opportunistic pathogen. *Virulence*. 2012;3(3):243-250.
14. Peleg A, Hooper D. Hospital acquired infections due to gram-negative bacteria. *N Engl J Med*. 2010;362(19):1804-1813.
15. Aronson N, Sanders J, Morgan K. In harm's way: infections in deployed American military forces. *Clin Infect Dis*. 2006;43:1045-1051.
16. Dallo S, Weitao T. Insights into *Acinetobacter* war-wound infections, bioflims and control. *Adv Skin Wound Care*. 2010;23(4):169-174.
17. Hawley J, Murray C, Griffith M, et al. Susceptibility of *Acinetobacter* strains isolated from deployed military personnel. *Antimicrob Agents Chemother*. 2007;51(1):376-378.
18. Hujer K, et al. Analysis of antibiotic resistance genes in multidrug-resistant

Acinetobacter sp. isolates from military and civilian patients treated at Walter Reed Army Medical Center. *Antimicrob Agents Chemother*. 2006;50(12):4114-4123.

19. Hospenthal D, Crouch H. Infection control challenges in deployed military treatment facilities. *J Trauma*. 2009;66(4:Suppl):S121-S128.
20. Rogers B, Aminzadeh Z, Hyashi Y, Paterson D. Country-to-country transfer of patients and the risk of multi-bacterial infection. *Clin Infect Dis*. 2011;53(1):49-56.
21. Magiorakos AP, Srinivasan A, Carey RB, et al. Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. *Clin Microbiol Infect*. 2012;18(3):268-281.
22. Francy T, Gaschen F, Nicolet J, Burnens AP. The role of *Acinetobacter baumannii* as a nosocomial pathogen for dogs and cats in an intensive care unit. *J Vet Intern Med*. 2000; 14:177-183.
23. Cohen A, Calfee D, Scott KF, et al. Recommendations for Metrics for Multidrug-Resistant Organisms in Healthcare Settings: SHEA/HICPAC Position Paper. *Infect Control Hosp Epidemiol*; 2008, 29(10):901-913.
24. Clinical and Laboratory Standards Institute (CLSI). Analysis and presentation of cumulative antimicrobial susceptibility test data; approved guideline – third edition. 2009.
25. Roger JL, et al. Antibiograms of multidrug-resistant clinical *Acinetobacter baumannii*: promising therapeutic options for treatment of infection with colisitin-resistant strains. *Clin Infect Dis*. 2007;45:594-598.
26. Baechler MC, Williamson J, Gilbride TL, et al. Building America Best Practices Series: Guide to Determining Climate Regions by County. 2010.
27. Sellick JA, Jr. The use of statistical process control charts in hospital epidemiology. *Infect Control Hosp Epidemiol*. 1993;14(11):649-656.

Acronym/Abbreviation List

Acronym/Abbreviation	Definition
ABC	*A. baumannii-calcoaceticus* complex
CENTCOM	United States Central Command
CHCS	Composite Health Care System
CL	Center Line
CLSI	Clinical and Laboratory Standards Institute
CO	Community-onset
CONUS	Continental United States
CY	Calendar year
DMDC	Defense Manpower Data Center
DMIS ID	Defense Medical Information System Identification number
DOD	United States Department of Defense
DOE	United States Department of Energy
DON	United States Department of the Navy
EDC	EpiData Center Department
HA	Healthcare-associated
HL7	Health Level 7
HO	Hospital-onset
IV	Intravenous
LCL	Lower Control Limit
M2	MHS Data Mart
MCRD	Marine Corp Recruit Depot
MDR	Multidrug-resistant
MEPRS	Medical Expense and Performance Reporting System
MHS	Military Health System
MTF	Military treatment facility
N/R	Not reportable
NOS	Not otherwise specified
OCONUS	Outside of the continental United States
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
PDR	Pandrug-resistant
PPDR	Possible pandrug-resistant
PXDR	Possible extensively drug-resistant
Q	Quarter (yearly)
SIDR	Standard Inpatient Data Record
SPC	Statistical Process Control
SSTI	Skin and soft tissue infection
UCL	Upper Control Limit
US	United States
WHO	World Health Organization
XDR	Extensively drug-resistant